Middle-East Journal of Scientific Research 2 (3-4): 124-127, 2007
ISSN 1990-9233

Evaluation of Cassava Genotypes for Resistance to the Cassava Anthracnose Disease (CAD) at Two Agroecoogical Zones (Ibadan and Jos Plateau) of Nigeria

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Abstract: Fifreen cassava genotypes were evaluated in the field in two cropping seasons at two locations (Ibadan: lowland-savanna zone, Jos plateau: mid-altitude) in Nigeria for their reaction to infection by *Colletotrichum gloesporiodes f. sp manihotis,* using injury score as the index for resistance. The data collected were distance of first canker from the soil (DCS) and total number of cankers per plant (TNC). The injury scores differed significantly ($P<0.05$) between the two agro-ecological zones, Ibadan and Jos plateau. Highest overall injury scores for CAD throughout the sampling period were recorded at Ibadan. Also, results showed that there were significant differences ($P<0.05$) between the two locations for DCS and TNC. Jos plateau had the lowest values for DCS and TNC when compared to Ibadan. Injury scores varied with genotype. TMS 30001, TMS 30572, TMS 91934 and TMS 50395 had the lowest mean disease injury score for CAD. Also, genotypic differences ($P<0.05$) were observed for DCS and TNC across locations and years. TME2, Danross, Danduala and Isunikankiyan had cankers developing at lowest level while TMS 30001, TMS 30572, TMS 4(2)1425, TMS 91934 and TMS 30337 had cankers higher upon the stem. TME2, Danduala, Danross and Isunikankiyan had the highest TNC whereas the lowest TNC were on TMS 30001, TMS 30572, TMS 4(2)1425, TMS 91934 and TMS 30337. Total dry root weight at Ibadan were higher than those obtained from Jos plateau. Also, some genotypes (TMS 30572, TMS 91934 and TMS 50395) which showed significant higher root yield had the lowest injury scores for CAD in either Ibadan or Jos plateau. Some of these genotypes (TMS 30572 and TMS 91934) which showed significant higher root yield and are more resistant to CAD should be recommend to the farmers or can be recommend for further breeding programme.

Key words: *Colletotrichum gloesporiodes f. sp manihotis* · cassava · genotype · resistance

INTRODUCTION

Cassava (*Manihot esculenta* Crantz) is the seventh most important crop of the world and constitutes a staple food for an estimated 800 million people, one-eighth of the world population [1, 2]. Diseases and pests constitute one of the greatest constraint to cassava production in Africa [3]. The yield losses vary with pests and diseases and the prevailing climatic conditions [4]. Of the diseases of cassava, African Cassava Mosaic Disease and Cassava Anthracnose Disease (CAD) are the most important diseases of cassava [4]. Although the causal agent of CAD is regarded as a weak pathogen, yet CAD is the most important fungal disease of cassava in the fungal disease of cassava in the field [5]. In recent years, CAD has become so important in the extent of damage to plants by reducing the amount of healthy plantable stems available to farmers; that a search for cultivars of cassava resistant to CAD become necessary. In Nigeria, cassava production has been seriously threatened CAD in recent years and different methods have been used in the control of this disease. These include cultural practices [6], use of resistant cultivars [7], biological control [8] and breeding for resistance [9]. Of these measures, the use of resistant cultivars and biological control offer a more permanent, sustainable and safe control of the pests and disesases [4].

The stability in yields of agronomically desirable and commercially acceptable cultivars is the ultimate goal in cassava improvement and a pre-requisite in achieving sustainability. One way to ensure this is to select cultivars with adequate levels of resistance to diseases under low

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temperatures. The objective of this study was to identify cassava genotypes that show low levels of damage by CAD in the two agro-ecological zones (Ibadan and Jos plateau) of Nigeria.

MATERIALS AND METHODS

Experimental location: These experiments were conducted in Nigeria at Jos plateau (mid-altitude) and Ibadan (lowland savanna zone). Two experiments were conducted during 1994/95 and 1995/96 crop seasons at International Institute of Tropical Agriculture (IITA), Ibadan and National Root Crop Research Institute field stations (Vom and Heipang) in Jos plateau. These two locations represent contrasting agroecological zones: Ibadan (altitude: 210 metres above sea level (masl), relative humidity: 65-90%, latitude: 4°46'N, longitude: 2°34'E, temperature: 28±6°C, rainfall: 1545mm) and Jos plateau ((a) Vom: altitude: 1280 masl, latitude: 9°55'N, longitude: 9°E, relative humidity: 55-85%, rainfall: 1099 mm, temperature: 18±5°C, (b) Heipang: Altitude: 1290 masl, latitude: 9°38'N, longitude: 8°9'E, relative humidity: 60-85%, temperature: 18±6°C, rainfall: 1153mm). The soil at Ibadan is classified as Oxic Paleuestalf, Alagba soil series [10] while in Jos plateau the soil is Ferruginous tropical soils [11].

Experimental design: Fifteen cassava genotypes were compared. They comprised eight improved IITA genotypes: TMS 4488, TMS 30337, TMS 30001, TMS 91934, TMS 4(2)1425, TMS 30572, TMS 50395, TMS 30555 and four landraces (local genotypes) commonly grown in south western Nigeria: TME1, TME11, Isunikankiyan and Oko-Iyawo; three landraces (local genotypes) adapted to mid-altitudes: Danduala, Danrahoss and Danwaru. Disease/pest free cassava stem cuttings of 20cm length were obtained from 12 month-old mother plants at the middle part of the stem. The stem cuttings were immersed in 0.05% of fungicidal benlate (a.i. = methyl 1-(butyl carbatomyl)-2-benzimidazole carbamate) solution to enhance the health status of the planting materials. The experiments were set up in each location as randomized block with three replications. Each plot had six rows, 10 m long. Spacing was 1 m between rows and 0.8 m within a row. Each plot contained 72 plants. The experiments were kept free of weeds by regular hand-weeding.

Data collection and analyses: Evaluation of the genotypes for resistance to CAD in the field was based on the injury done to each genotype by disease. Disease severities for CAD was scored visually on a plot basis on a scale of 1-5 per individual plant, it was based on the natural development of CAD symptoms [4, 5]. Disease severity was scored on a scale of 1-5 where: 1: no symptom (resistant); 2: development of shallow cankers lower on the stem; 3: development of successive cankers higher up the plant with older cankers becoming larger and deeper; 4: development of dark brown lesions on green shoots, petioles and leaves, young shoots collapse and are distorted; and 5: wilting and drying up of shoots and young leaves and death of part of or whole plant. The assessment of the genotypes was carried out until it was 6 months after planting, when plants were too high and the canopies had closed up making scoring impracticable, the final score was recorded. The data on plant damage was collected on the four middle rows per plot which at maturity were used for yield data. Also, collected were height of the first canker from the ground level and number of cankers per plant. Harvesting was done at 12 months after planting when tuberous root dry weights were recorded. Data were collected at monthly intervals up to 6 months. Two years data for (1994-1996) were pooled and subjected to analysis of variance using SAS [12]. The general linear model (GLM) procedure was used for producing analyses of variances and were computed as differences between treatment means and compared by Least Significant Test at $P<0.05$.

RESULTS AND DISCUSSION

The injury scores differed significantly ($P<0.05$) between the two locations (Fig. 1). Highest overall injury scores for CAD were recorded at Ibadan (Fig. 1). Also, results showed that there were significant differences ($P<0.05$) between the two locations for DCS and TNC. Jos plateau had the lowest values for DCS and TNC when compared to Ibadan (Fig. 1). The lower injury scores for CAD in cassava genotypes grown in Jos than those in the Ibadan, confirms the significance of interaction between location and cultivars on disease infestation in cassava. Differences in disease development at Ibadan and Jos plateau were probably due to higher concentration of inoculum in the surrounding cassava fields at Ibadan. The resistance of cassava genotypes to disease attack when exposed to natural conditions of infestation and spread of disease was reported by Hahn *et al.* [5].

Results showed that injury scores varied with genotype. TMS 30001, TMS 30572, TMS 91934 and TMS 50395 had the lowest mean disease injury score for CAD (Table 1). Also, genotypic differences ($P<0.05$) were

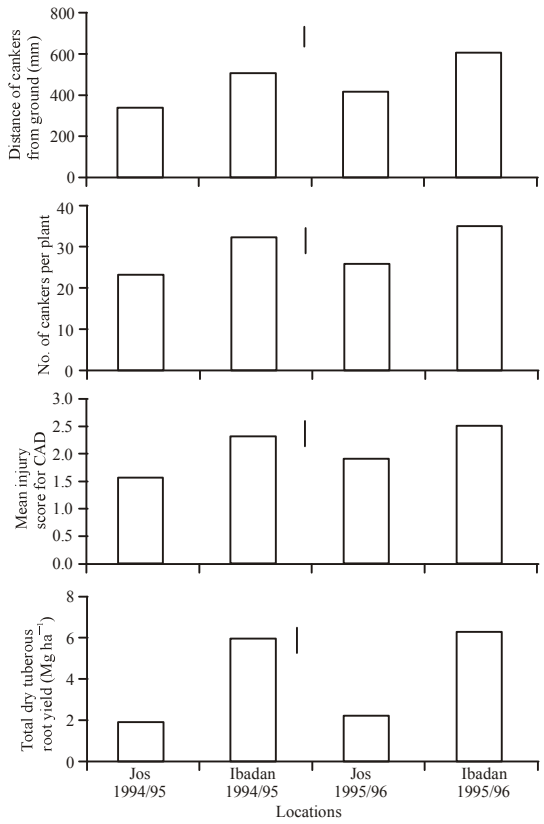

Fig. 1: Effect of locations and years on distance of cankers from ground, number of cankers per plant, mean injury score for CAD and tuberous root yield of 15 cassava genotypes from 1994-1996

observed for DCS and TNC across locations and years (Table 1). TME2, Danross, Danduala and Isunikankiyan had cankers developing at lowest level while TMS 30001, TMS 30572, TMS 4(2)1425, TMS 91934 and TMS 30337 had cankers higher upon the stem (Table 1). From the results, the genotypes with cankers higher up on the stem is better; since, they tuberized before the onset of the disease hence yield may not adversely affected. TME2, Danduala, Danross and Isunikankiyan had the highest TNC whereas the lowest TNC were on TMS 30001, TMS 30572, TMS 4(2)1425 and TMS 91934 (Table 1). The advantage of using genotypes with low number of cankers are: (i) the fewer the number of disruptions on the stem shoots, the lower the discontinuity in the tissue that would prevent timely delivery of elaborated resources and minerals to all parts of the plants; (ii) the fewer the number of cankers on stem and shoots, the lesser the amount of elaborated energy required for wound healing hence the energy would be channeled towards yield; and (iii) the fewer the number of cankers, the lower the risk of stem

Table 1: Parameters used for screening cassava genotypes in the field for resistance to Cassava Anthracnose Disease (CAD) and dry tuberous root weight as affected by locations

Genotypes	Distance of cankers from ground (mm)	Number of cankers per plant	Mean injury score for CAD	Tuberous root dry weight (Mg ha^{-1})
Ibadan				
TMS 50395	799.6	13.2	2.1	8.9
TMS 30555	425.2	17.9	2.0	7.4
TMS 4488	189.9	16.5	1.9	6.2
TMS 30337	639.5	14.6	2.3	5.2
TMS 30001	728.4	12.8	1.8	7.1
TMS 30572	689.1	12.4	1.9	10.4
TMS 4(2)1425	651.6	11.3	2.1	9.2
TMS 91934	710.5	13.9	2.2	9.3
Oko-Iyawo	178.0	20.8	2.3	7.4
Isunikankiyan	190.9	63.7	3.1	3.3
Danwaru	365.5	28.6	2.9	1.9
Danduala	201.6	74.4	2.9	2.2
Danross	269.8	70.9	2.8	1.8
TME1	541.4	23.7	1.9	7.1
TME11	160.9	69.6	3.1	5.9
LSD (0.05)	253.0	15.3	0.9	2.3
Jos plateau				
TMS 50395	519.3	19.3	1.2	1.2
TMS 30555	365.9	16.1	1.6	1.5
TMS 4488	325.5	31.9	1.3	1.9
TMS 30337	551.4	12.5	1.8	1.2
TMS 30001	547.3	13.7	1.1	2.0
TMS 30572	506.3	10.2	1.3	3.7
TMS 4(2)1425	468.8	15.6	1.1	1.6
TMS 91934	517.9	16.2	1.4	2.6
Oko-Iyawo	196.5	17.0	2.6	2.2
Isunikankiyan	268.1.	61.4	2.9	0.4
Danwaru	385.8	38.6	1.8	2.3
Danduala	289.9	64.9	2.6	1.0
Danross	311.9	59.5	2.2	1.0
TME1	511.5	38.7	1.7	5.1
TME11	166.7	51.2	2.3	2.8
LSD (0.05)	211	10.2	0.8	1.2

breakage during storm, thus more planting material would be available for the next planting season. So, there is a need to recommend genotypes with fewer number of cankers.

Data obtained on dry tuberous root yield at 12 MAP in two locations in the two planting seasons (Table 1) show that dry root weight at Ibadan were higher than those obtained from Jos plateau. Also, some genotypes (TMS 30572, TMS 91934 and TMS 50395) which showed significant higher root yield had the lowest injury scores for CAD in either Ibadan or Jos plateau (Table 1). The

differences in disease severity among the genotypes are attributed to inherent resistance mechanisms. Differences in resistance of cassava cultivars to diseases have been reported by Hahn *et al.* [5] and Rossel *et al.* [13].

CONCLUSIONS

The results of this study has shown that the impact of the attack of CAD on cassava can be reduced significantly in Jos plateau (mid-altitude) by the use of resistant genotypes. TMS 30001, TMS 91934, TMS 4(2)1425 and TMS 30572 appeared to be more resistant to disease as compared to other tested genotypes. Some of these genotypes (TMS 30572 and TMS 91934) which showed significant higher root yield and are more resistant to CAD should be recommend to the farmers.

ACKNOWLEDGEMENTS

This study was funded by the core budget of International Institute of Tropical Agriculture (IITA). The support provided by Dr. K.C. Okonkwo of National Root Crops Research Institute Station at Vom, Jos plateau; Dr. I. J. Ekanayake of IITA and Dr. A.O. Togun of University of Ibadan, Ibadan, Nigeria are gratefully acknowledged.

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